WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2005LA38G

Title: Saltwater Intrusion Management with Conjunctive Use of Surface Water and Ground Water

Project Type: Research

Focus Categories: Groundwater, Management and Planning, Solute Transport

Keywords: Management modeling, Saltwater Intrusion, Optimization, Conjunctive Use

Start Date: 09/01/2005

End Date: 08/31/2008

Federal Funds: $172,842

Non-Federal Matching Funds: $173,616

Congressional District: Louisiana

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Abstract

The goal of the project is to develop a saltwater intrusion management model to mitigate saltwater intrusion problem, increase water availability, and sustain ground water productivity. Saltwater intrusion in coastal aquifers is a nationwide problem, which has caused ground water supply shortage, decrease in water availability, drinking water contamination, land subsidence, and estuary ecosystem destruction along the coastal perimeter of the United States. Saltwater intrusion into the drinking water aquifers due to excessive withdrawals has been reported in the southern California, southern Florida, and Gulf of Mexico coastal areas. Many coastal metropolitan cities have been experiencing severe saltwater intrusion and consequent economic impact due to lack of an appropriate ground water management plan. The East Baton Rouge Parish in Louisiana is one of them, which is located on the Southeastern Louisiana aquifer system. Although the project will be focusing on the saltwater intrusion management in the Southeastern Louisiana aquifer system, other saltwater intruded areas across the country with the similar problem would benefit from the project.

As stated in Louisiana legislature Act 446 (2001) and Act 49 (2003), ground water must be managed, protected, and regulated in the best interests of all the citizens of the state. Development of a ground water resource management program is necessary to meet the goal of long-term sustainability of the states ground water aquifers and to sustain the economic welfare of the states citizens. The specific objectives of the project include (1) saltwater intrusion modeling to better understand the groundwater flow and saltwater encroachment; (2) a saltwater intrusion barrier (SIB) system development using a series of surface water injection wells to prevent further saltwater intrusion as well as enhance groundwater availability; and (3) a pump-and-treat (P&T) remediation design to clean up the brackish water residing in the aquifers.

In the project, SEAWAT will be adopted to develop a three-dimensional saltwater intrusion simulation model in which the parameter heterogeneity will be characterized and estimated through the generalized parameterization (GP) method and an automatic inverse procedure. The minimization approach in the inverse problem will be based on a global-local optimization approach. The saltwater intrusion management model includes injection and pumping wells selection optimization, injection and pumping rates optimization, and schedule optimization in the proposed SIB system and P&T design. As a consequence, the saltwater intrusion management model is formulated as a mixed integer nonlinear programming (MINLP) problem. The project proposes a decomposition method and embedded global-local method to cope with the MINLP problem.

Research, management practices, and education will benefit from this project. The project outcomes will provide information to visualize and predict performance of clean-up scenarios before implementing the actual work. Moreover, the management model will be distributed to user groups who are coping with saltwater intruded areas. The project will directly benefit the university researchers and USGS through collaborative activity and has a potential impact on education, public awareness, and administrations. The project will assist USGS in developing cost-effective strategies for water availability information to Congress and the public. Also, the management model will serve as an educational and research tool to promote the understanding of urgency of ground water management to undergraduate and graduate students.